

Ansys

2022/R1

Engineering Total Solution
Engineering What's Ahead.

新技術線上研討會

4/6 (三)
14:00-14:40

Ansys Mechanical 進階應用_新技術線上研討會
(Meshing、Reinforcement & Structural Optimization)

王弘政

4/6 (三)
15:00-15:40

Ansys LS-DYNA 新技術線上研討會
(LS-DYNA Solver & Contact Enhancements)

康盛捷

4/6 (三)
16:00-16:40

Ansys LS-DYNA 新技術線上研討會
(Implicit Frequency Domain Analysis)

洪翌程

NVIDIA QUADRO RTX 4000

即時即刻加速改變

透過 GPU 加速光線追蹤、深度學習和進階著色，滿足現今最苛的專業工作流程需求。採用 NVIDIA Turing™ 架構和 NVIDIA RTX™ 平台的 NVIDIA® Quadro RTX™ 4000，提供單插槽 PCI-e 尺寸同級最佳的效能與功能。加速獲得深入分析和解決方案的時間，以前所未有的方式設計與創造。

立即購買



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Introduction to ANSYS Implicit for Frequency Domain

隱式求解頻域相關分析介紹

Implicit Frequency Domain Analysis

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Tel: +886 04 2296 6080

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LS-DYNA?

What's

- **ANSYS LS-DYNA** is the most commonly used **explicit simulation** program, capable of simulating the response of materials to **short periods** of severe loading. Its many elements, contact formulations, material models and other controls can be used to simulate complex models with control over all the details of the problem.

Typical Uses

- **Changing Boundary Conditions** (Such as Contact between parts that changes over time)
- **Large Deformation** (For example the crumpling of sheet metal parts)
- **Nonlinear Materials that do not exhibit ideally elastic behavior** (Thermoplastic polymers)

Classification

Problem Time

Long trem

10 sec

1 sec

0.1 sec

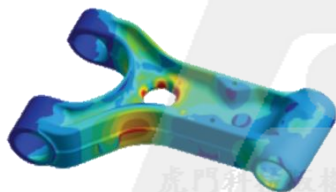
0.01 sec

0.001 sec

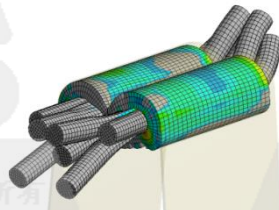
0.0001 sec



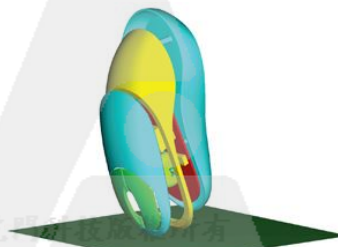
Creep



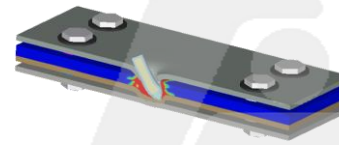
Static/Dynamic



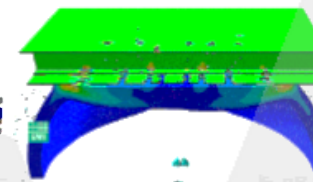
Quasi-Static



Drop / Impact



Ballistics



Detonation
Blast



Hypervelocity
Impact

Nonlinear Mechanics

Implicit

Explicit

Methods

ANSYS

Industries



Automotive

Crash & Occupant Safety
NVH & Durability
Battery Reliability



Civil Engineering

Blast Proofing
Earthquake Safety
Tents



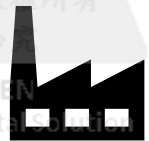
Aerospace

Bird Strike
Blade-off Containment
Crash



Electronics / Hi-Tech

Drop Analysis
Package



Manufacturing

Forming
Stamping
Machining



Military Force

Projectiles and Weapons
Blast and Penetration
Underwater Shock Analysis



Consumer Products

Packaging
Switches



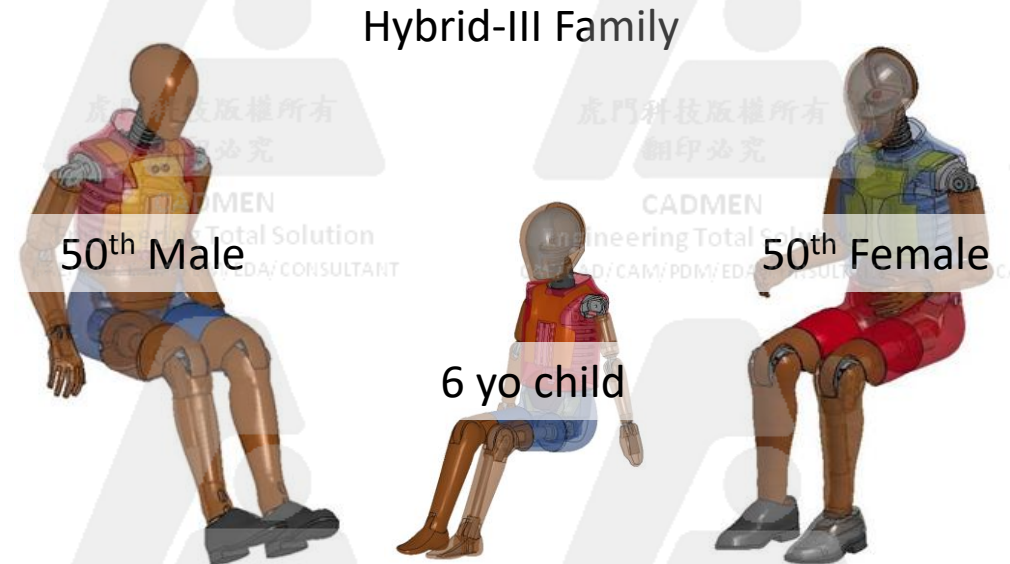
Bio-Medical

Devices & Equipment
Medical procedures

Automotive Safety



Vehicle Crashworthiness

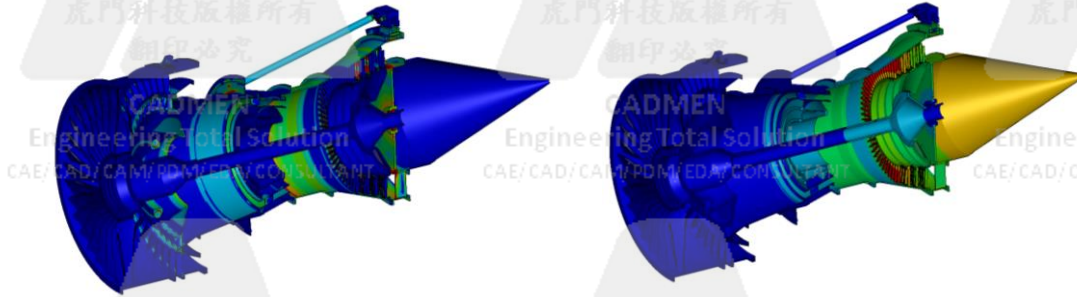


Dummy for LS-Dyna



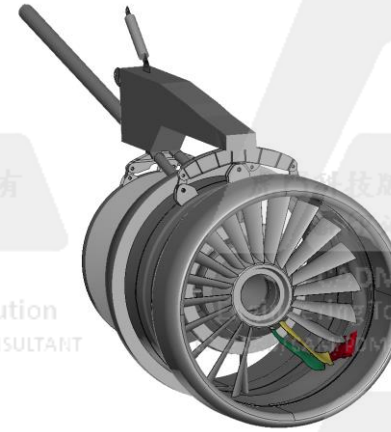
Aircraft Engine Applications

"Whole Engine" Stress and Temperature Simulations



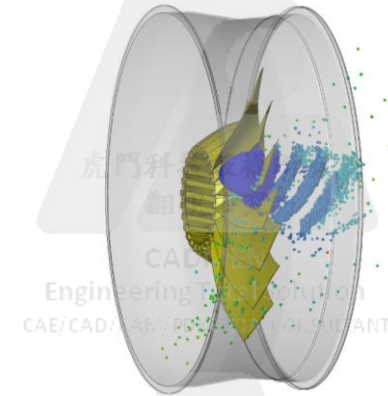
Confidential: Courtesy of Rolls-Royce

Blade Out



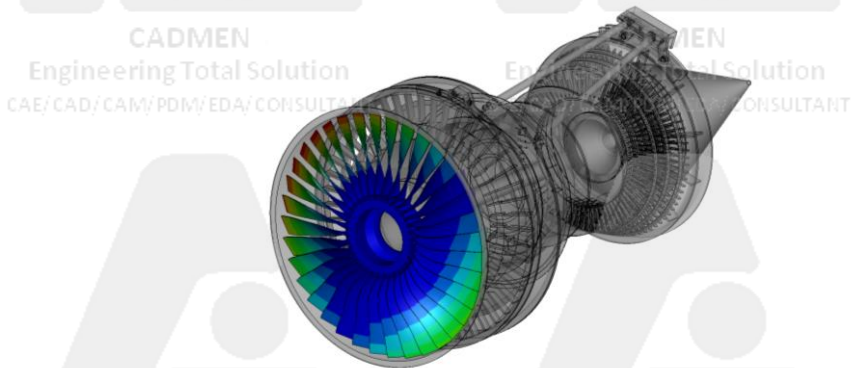
Fan blade off event – Generic Fan Rig Model
Courtesy of LS-DYNA Aerospace Working Group

Bird Strike



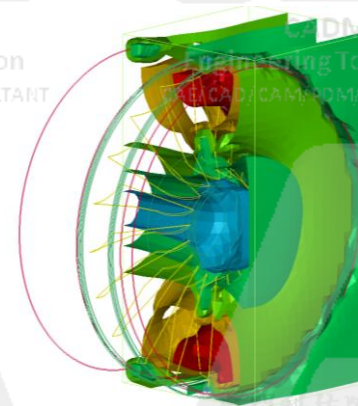
Bird strike – bird modelled with SPH approach
Courtesy of LS-DYNA Aerospace Working Group

Large Scale Vibration Analysis

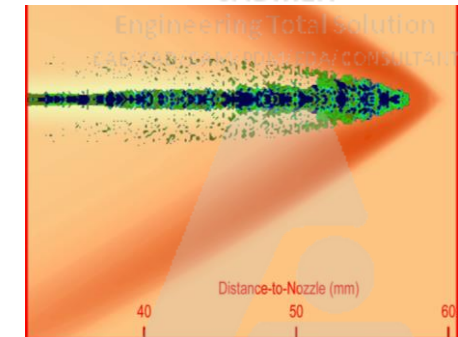


Confidential: Courtesy of Rolls-Royce

FSI / Combustion

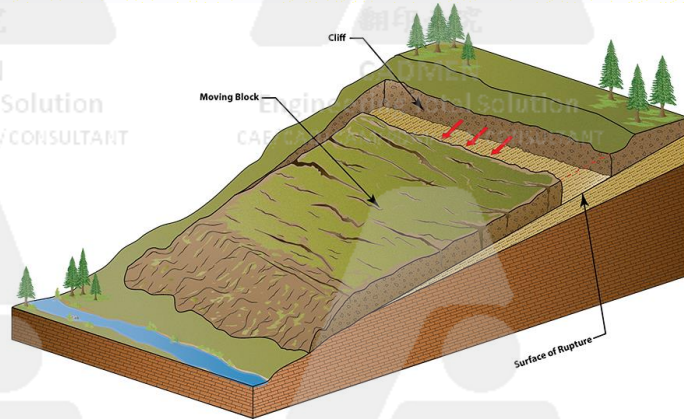
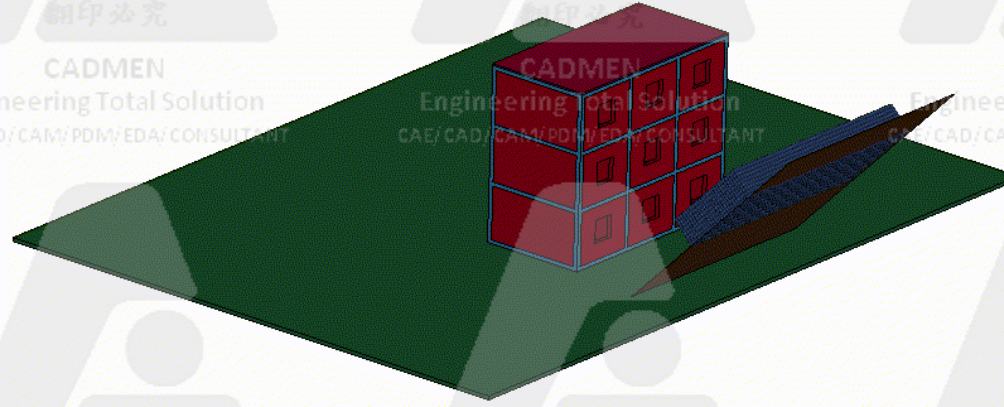


Fluid structure interaction



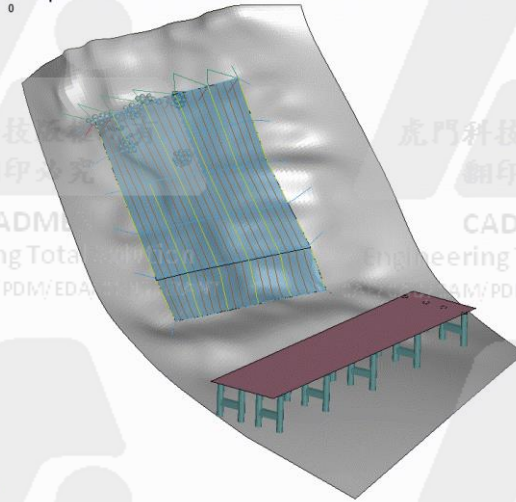
Fuel injection

Civil Engineering



Landslide Impact Simulation

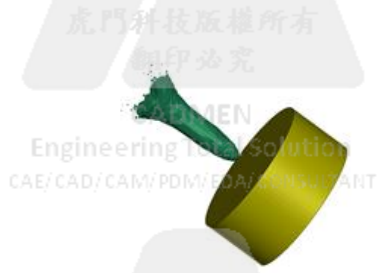
LS-DYNA user input
Time = 0



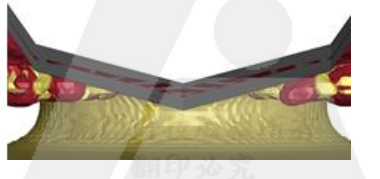
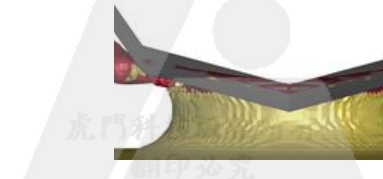
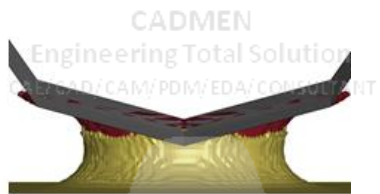
Net Barriers Debris-Flow Protection

/ Lethality & Survivability

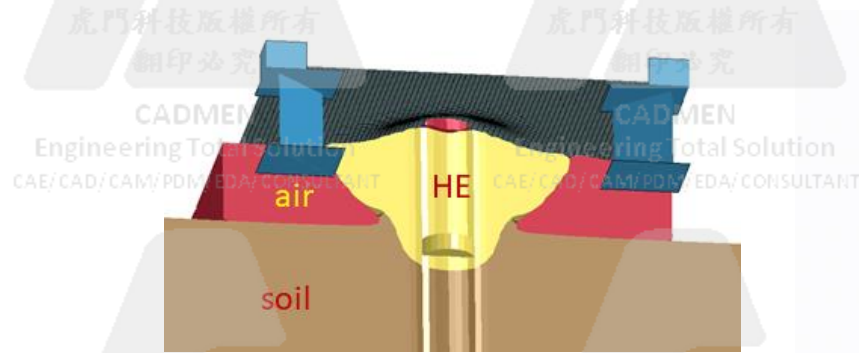
Armor Design



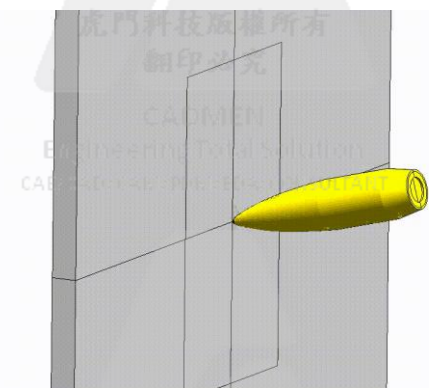
Explosive & Weapon System Development



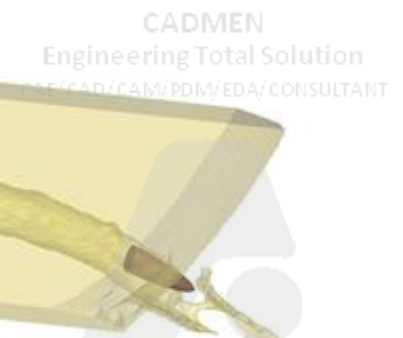
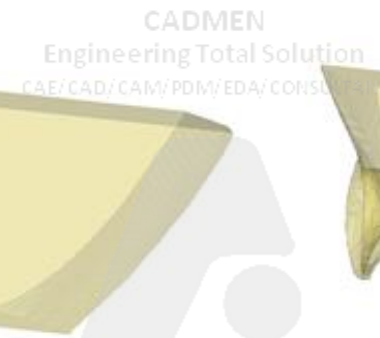
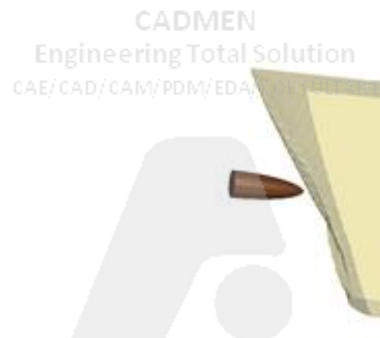
Blast Analysis



Ballistic Impact



Bullet penetration



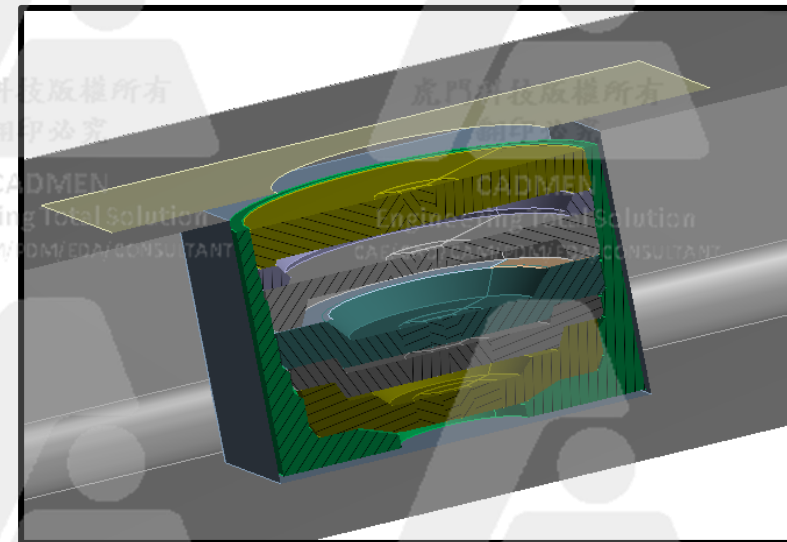
Lens Application

Dynamic Simulation Drop Test



Problem Description

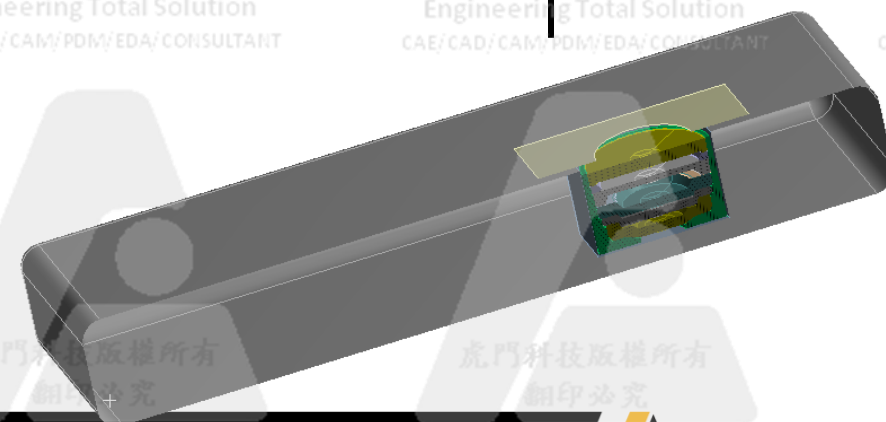
- 了解鏡頭模組掉落測試時的變形，並觀察各鏡片的相對位置
- 因組裝鏡頭時為緊配，因此需要考量模型初始預應力



結構靜態分析

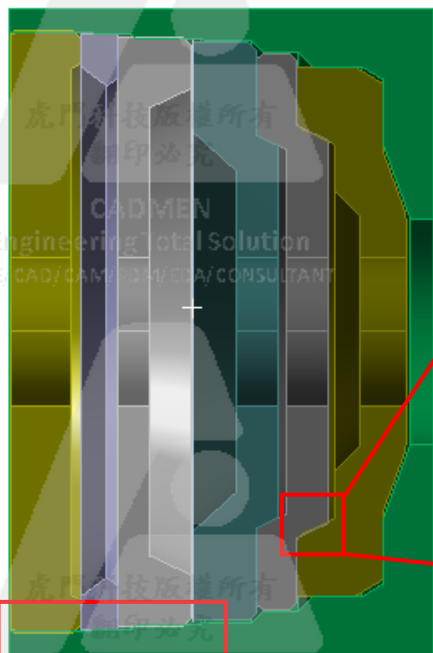


LS-DYNA

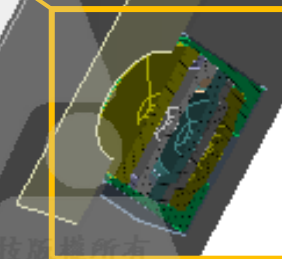
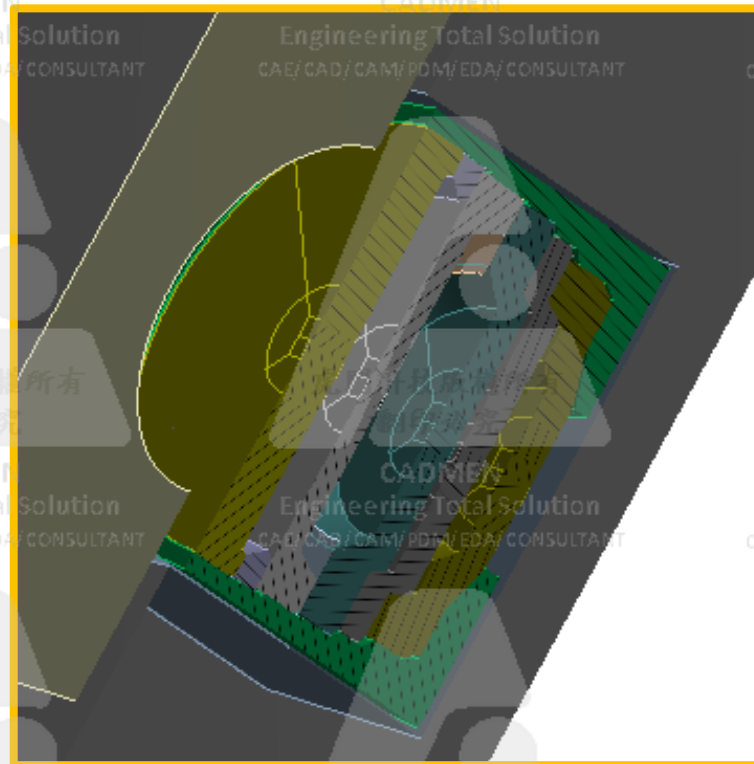


Model

Mechanical-Static Structural
鏡頭模組預應力解析
(鏡片與鏡筒干涉)

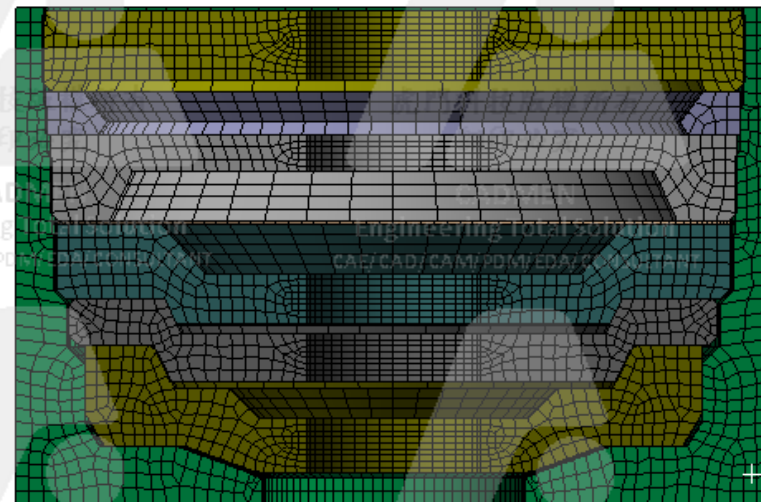
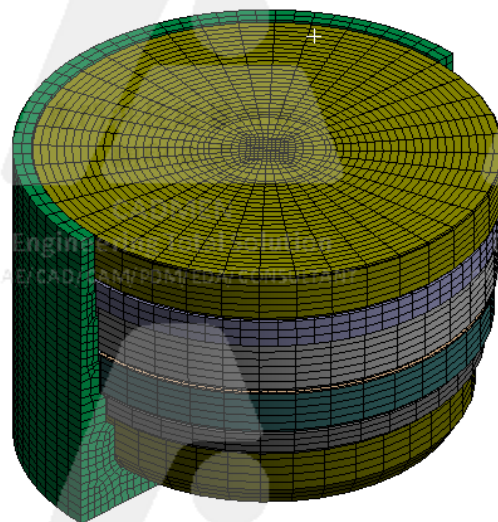


Workbench LS-DYNA (ACT)
鏡頭模組掉落測試模擬
(鏡頭模組與治具間隙0.1mm)

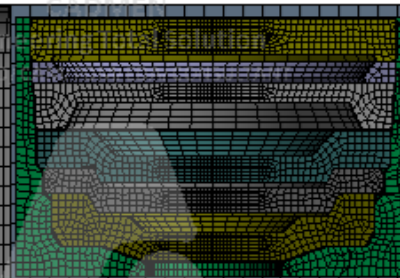
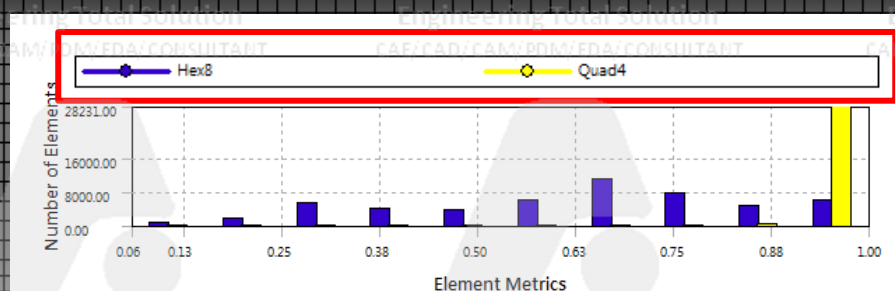


Model

- 治具模擬手機外殼故簡化為薄殼(Shell)
- 透過3D模型與選用適當的網格方法，可作成全六面體(solid)或四邊形(shell)之網格模型。



Statistics	
☒ Nodes	90638
☒ Elements	78824



分析手法

ANSYS Workbench LS-Dyna

	C
1	Static Structural
2	Engineering Data ✓
3	Geometry ✓
4	Model ✓
5	Setup ✓
6	Solution ✓
7	Results ✓

Prestress Analysis - Full Model (camera & box)

	D
1	Workbench LS-DYNA
2	Engineering Data ✓
3	Geometry ✓
4	Model ✓
5	Setup ✓
6	Solution ✓
7	Results ✓

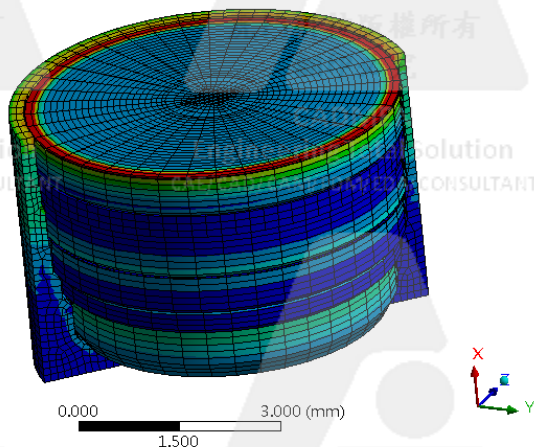
Camera Drop Test

預應力自動匯入

Step 1 預應力分析

C: Prestress Analysis - Full Model (camera & box)
Equivalent Stress
Type: Equivalent (von-Mises) Stress - Top/Bottom
Unit: MPa
Time: 1
2017/8/9 下午 02:14

74.439 Max
10
8.75
7.5
6.25
5
3.75
2.5
1.25
1.9385e-13 Min



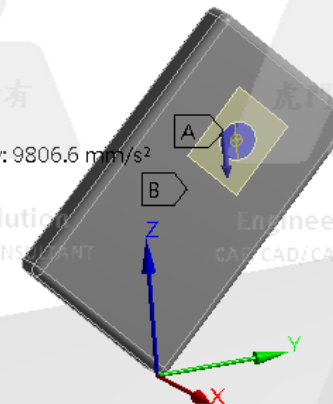
ANSYS
R18.1

Stress

Step 2 掉落分析

D: Camera Drop Test
Rigid Wall
Time: 1.e-003 s
2017/8/9 下午 02:15

A Velocity: 4430 mm/s
B Standard Earth Gravity: 9806.6 mm/s²



解析時間0.001s(1ms)
自1公尺高轉45度自由落下

隱式法之延伸應用

• 客製、消費性產品

結構剛性評估
熱傳評估
震動相關分析應用
輪胎噪音

• 航太產業

起落架結構分析
航太渦輪引擎啟動
飛機座椅安全性評估
衛星結構應力與震動分析

• 車輛產業相關

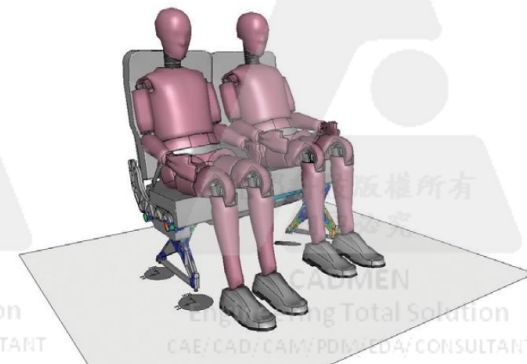
引擎機構相關設計之靜態評估
車體自重評估 (懸吊)
車門絞鍊設計
假人乘坐預分析
安全帶預張力
車體主結構之結構剛性設計
車體主結構模態分析

等等...

LS-Dyna Implicit to Explicit!!



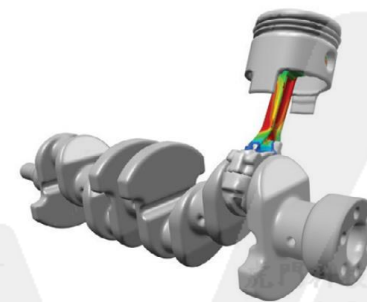
/ Aerospace Seat Pre-Loading



/ Door Sag



/ Crank Shaft



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EV Stiffness Improvement

LS-Prepost Modeling

Static Stiffness Evaluation

Modal Analysis

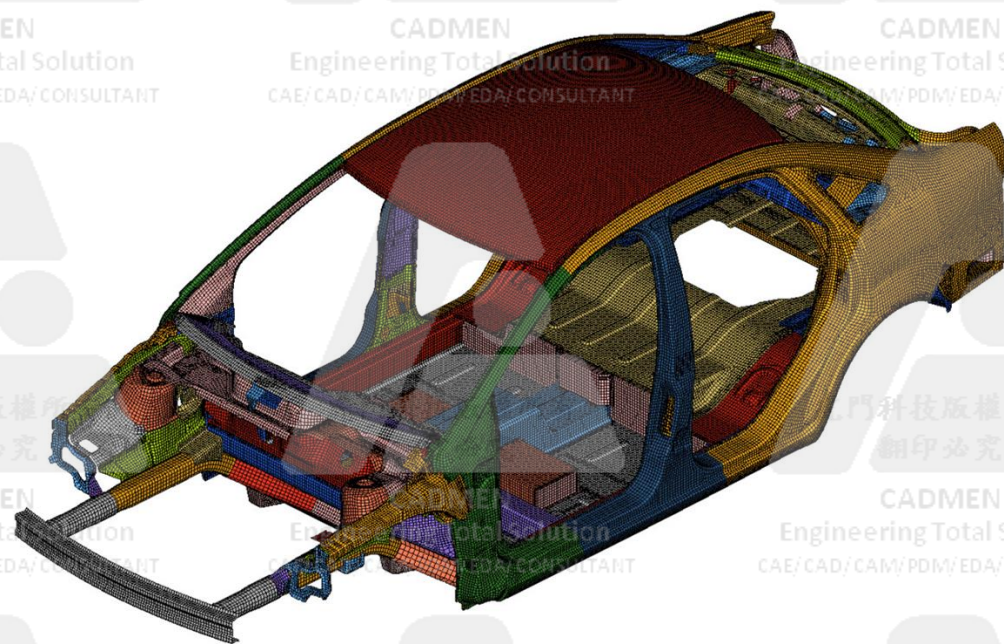
Crashworthiness Simulation

Ansys



- 電動車車體結構與一般傳統引擎汽車大致相同，包含車體主結構(Body In White, BIW)附加蓄電系統、驅動系統、懸吊系統、轉向系統、內裝以及外觀鈑件等，因此車體主結構必須具備足夠之剛性，承受零組件、乘員以及來自路面之負載
- 於道路行駛時，若發生碰撞意外，可能導致供電模組短路引發電路起火燃燒，甚至電池模組遭鈑件刺穿導致爆炸危害人身安全。本研究利用動態模擬分析評估車體結構安全設計，碰撞條件皆是依據FMVSS之規定，**評估假人傷害指數並且檢視結構、油箱與電池盒受損情形**

Finite Element Model

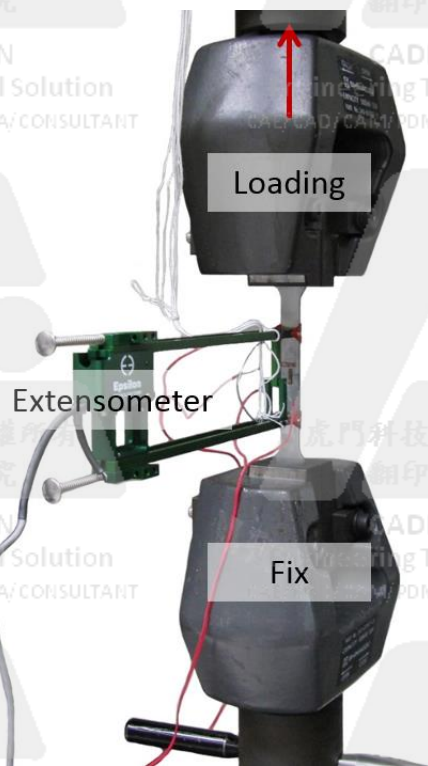


Waterfall Distribution Model

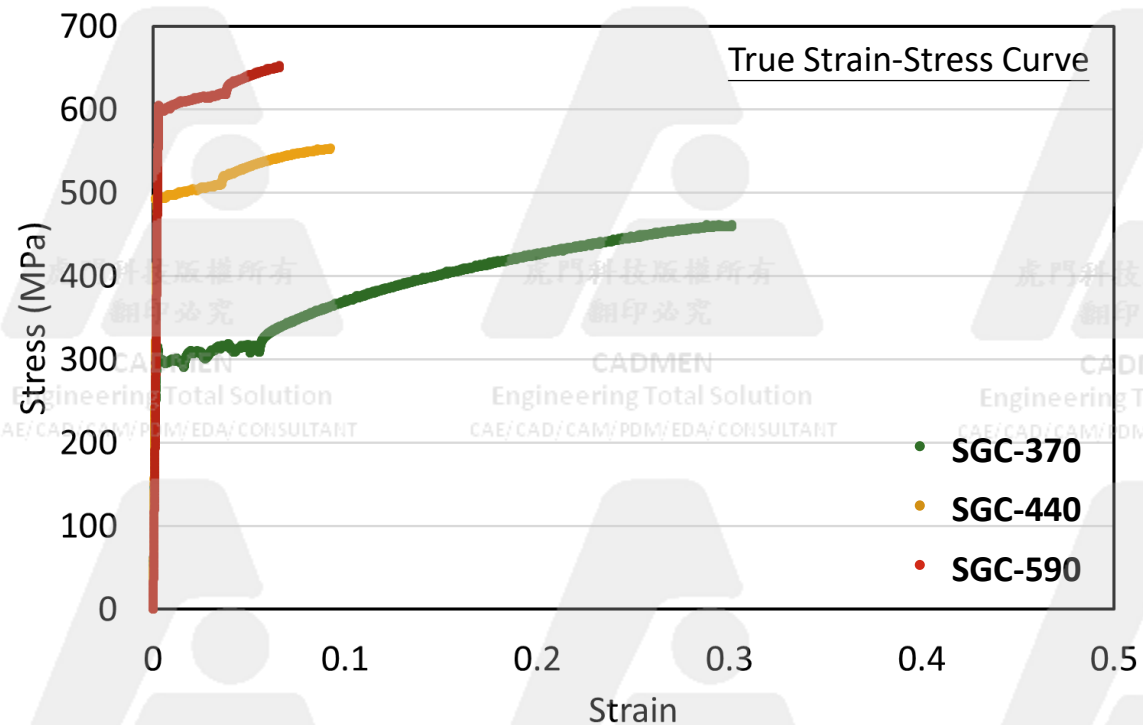
Model Information

Number of Element	270,555
Number of Node	383,838
Element Formulation	#18 Fully Integrated Linear DK Shell
Element Type	4 Node Shell
Material	Steel
Weight of BIW	349.80 kg
Number of Spotweld	4,336

Material Property



Specimen for Tensile Test



From : "American Society for Testing and Material E 8M-04.

Spot Weld Parameter

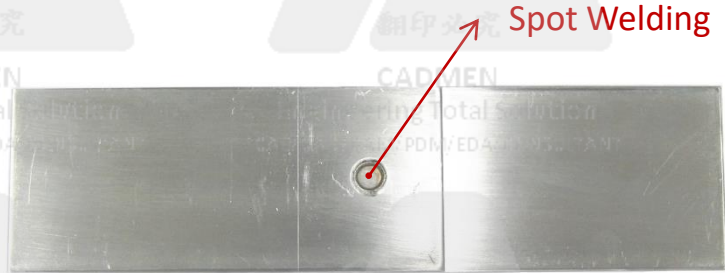
Property : Shear / Normal Failure

Lap Shear Testing

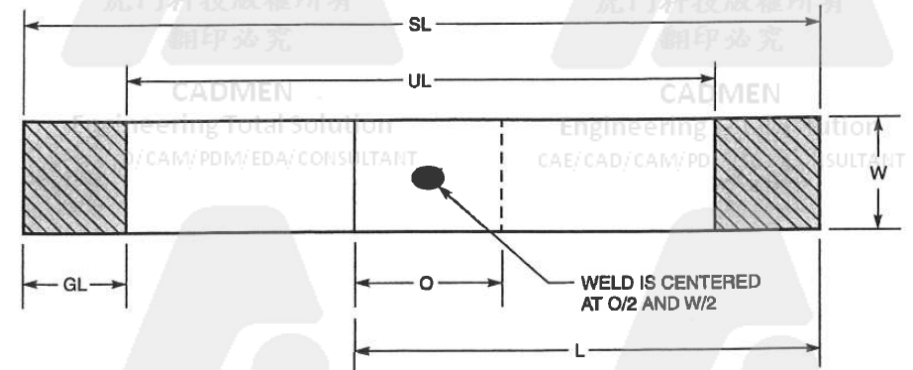
Cross Tension Testing



Lap-Shear Testing



Specimen

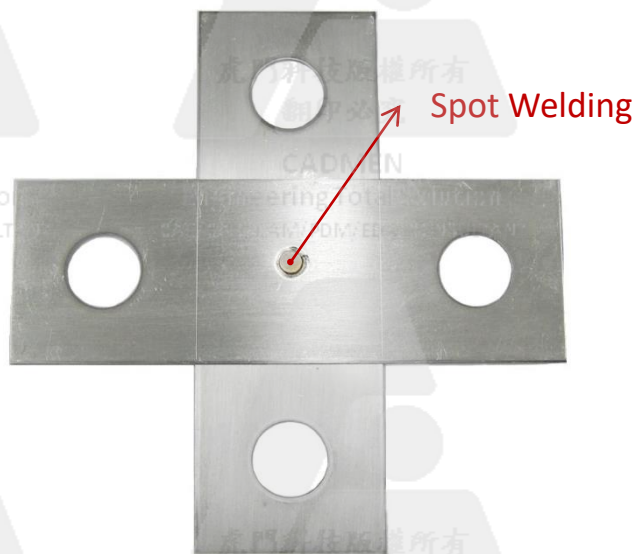


AWS Schematic for Shear Tension Samples

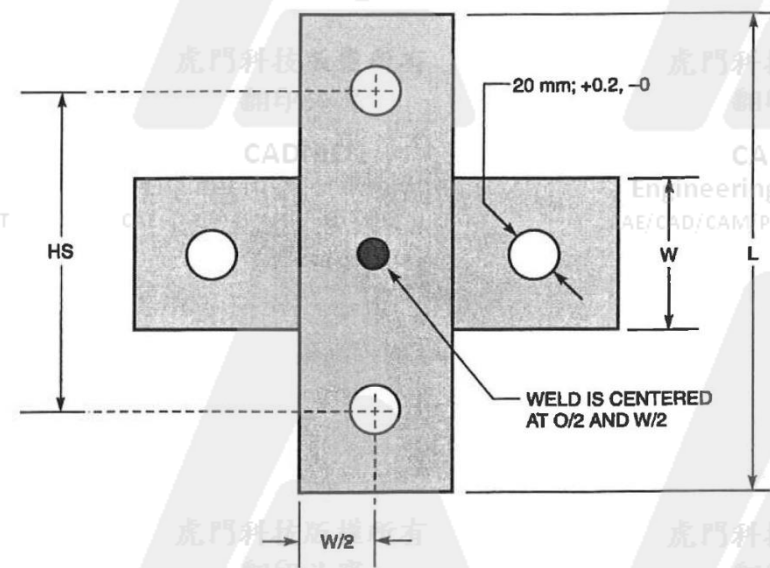
Shear Tension Sample Dimensions (mm)

Sheet Thickness	Coupon Length (L)	Coupon Width (W)	Overlap (O)	Sample Length (SL)	Unclamped Length (UL)	Gripped Length (GL)
0.60-1.29	105	45	35	175	95	40
1.30-3.00	138	60	45	230	105	62.5

Cross-Tension Testing



Specimen



AWS Schematic for Cross Tension Samples

Cross Tension Sample Dimensions (mm)

Sheet Thickness	Coupon Length (L)	Coupon Width (W)	Overlap (O)	Hole Spacing (HS)
0.60-3.00	105	45	35	100

Summery Table

Items \ Material		SGC-370	SGC-440	SGC-590
Lap-Shear Testing (kN)	I	10.79	13.11	10.52
	II	10.83	13.52	10.53
	III	11.02	13.48	12.06
	Average	10.88	13.37	10.53
Cross Tension Testing (kN)	I	8.16	11.56	6.57
	II	7.84	10.93	7.48
	III	8.10	11.70	5.47
	Average	8.03	11.40	7.03

*CONSTRAINED_SPOTWELD (4984)

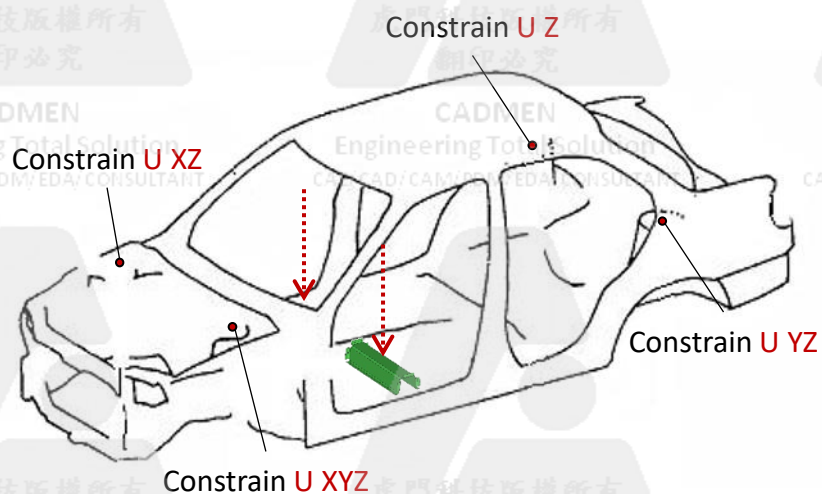
1	<u>WID</u>							
	1							
2	<u>N1</u> ☐	<u>N2</u> ☐	<u>SN</u>	<u>SS</u>	<u>N</u>	<u>M</u>	<u>TF</u>	<u>EP</u>
	1089888	1089030	8035.4170	1.088e+04	2.0000000	2.0000000	1.000e+20	1.000e+20

Structure Stiffness & Modal Analysis

- Structure Stiffness :
Bending and Torsion Stiffness
- Modal Analysis :
Mode Shape and Nature Frequency



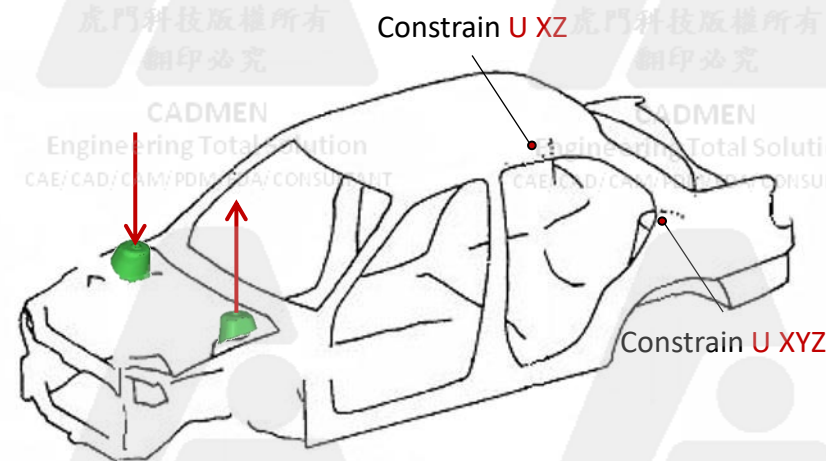
Boundary and Loading Condition



Load Condition : Pressure

$$K_b = \frac{F}{\delta}$$

Bending Stiffness

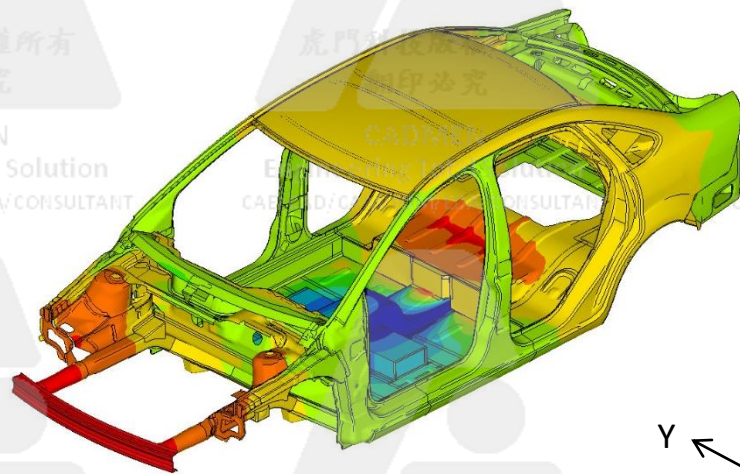


Load Condition : Nodal Force

$$K_t = \frac{T}{\theta}$$

Torsion Stiffness

Bending Stiffness



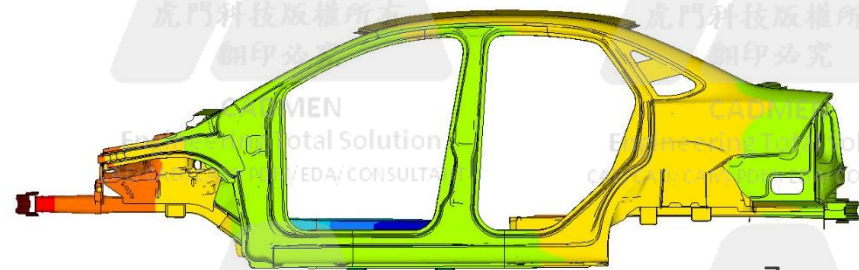
Iso view

Z-Displacement

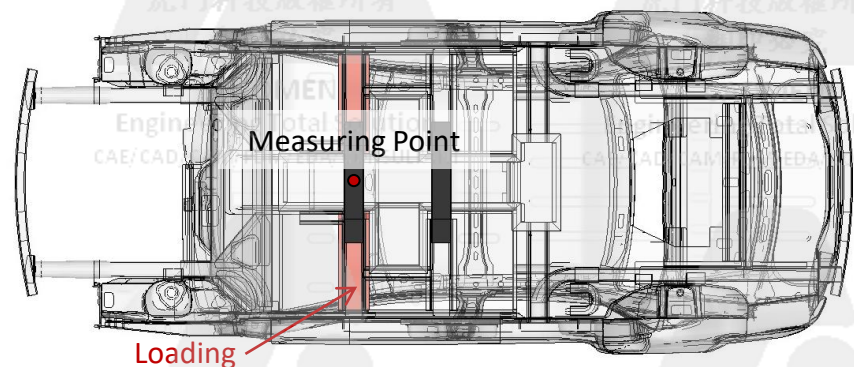
Nodal Displacement = 0.72 mm

Bending Stiffness

$$K_b = 2724.07 \text{ N/mm}$$

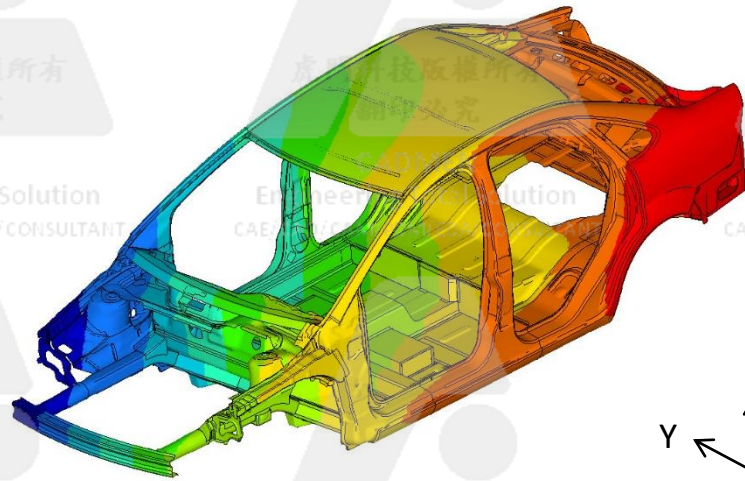


Side view



Bottom view

Torsion Stiffness



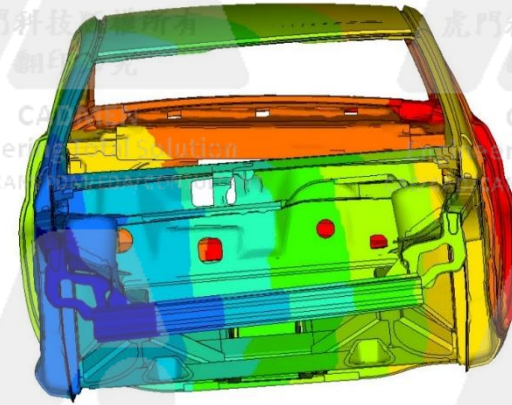
Iso view

Z-Displacement

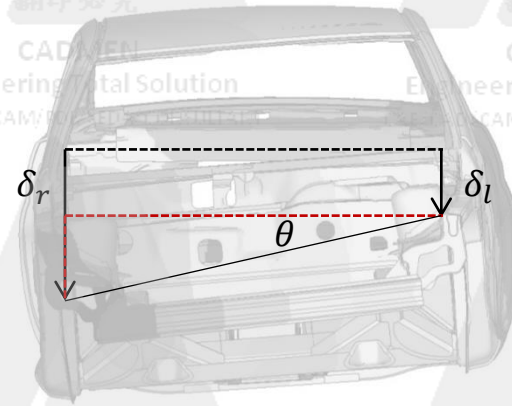
$$\delta_l = -1.24 \text{ mm}, \delta_r = -5.54$$

$$\theta = \tan^{-1} \left[\frac{|\delta_l + \delta_r|}{L} \right] = 0.22^\circ$$

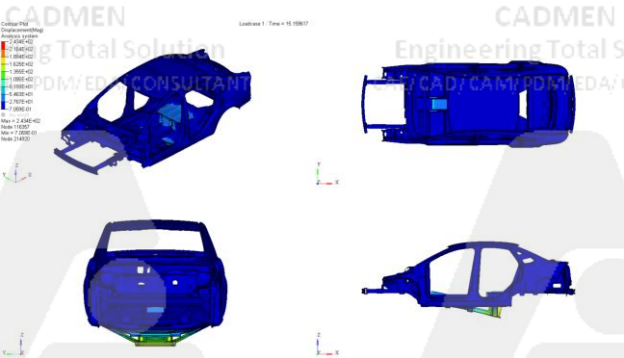
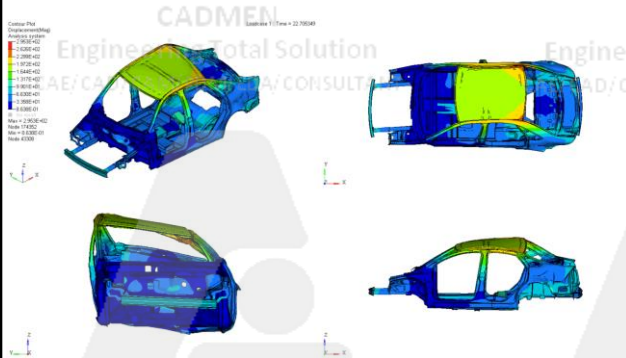
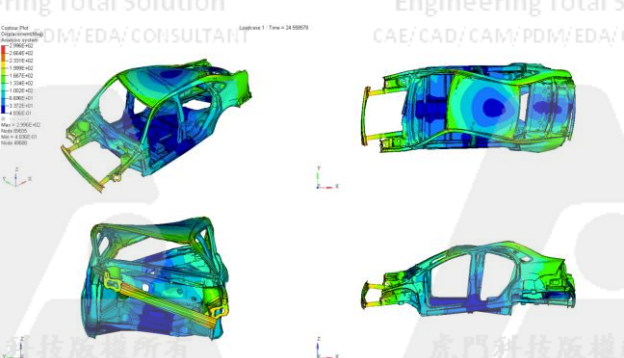
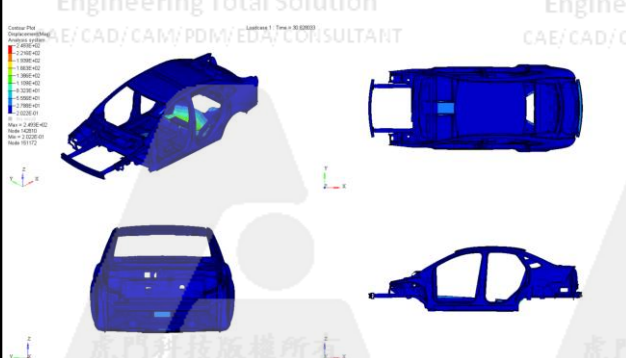
Torsion Stiffness $K_t = 5184.16 \text{ N-m/degree}$



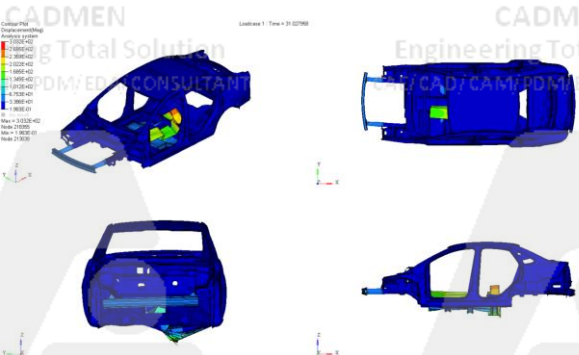
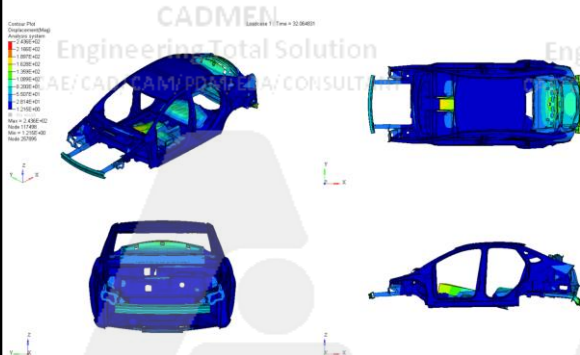
Front view



Modal Analysis Result

Structure Original Design (USUM)			
φ_n	1 st Mode Shape	φ_n	2 nd Mode Shape
	15.16 Hz		22.71 Hz
Local Bending Mode (Battery)		Global Shear Mode	
φ_n	3 rd Mode Shape	φ_n	4 th Mode Shape
	24.56 Hz		30.83 Hz
Global Torsion Mode		Local Bending Mode (Rear Floor)	

Modal Analysis Result

Structure Original Design (USUM)			
φ_n	5 th Mode Shape	φ_n	6 th Mode Shape
	31.03 Hz		32.06 Hz
Local Torsion Mode (Battery)		Local Bending Mode (Battery & Rear End)	

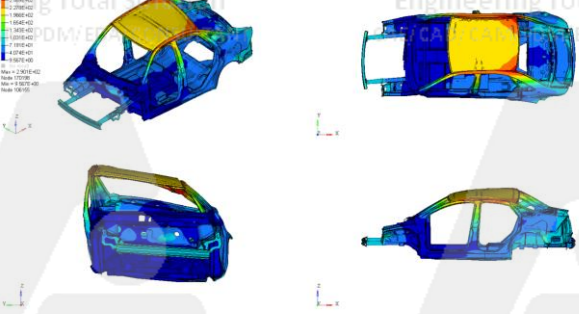
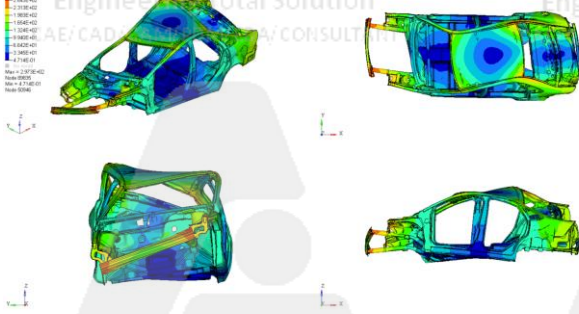
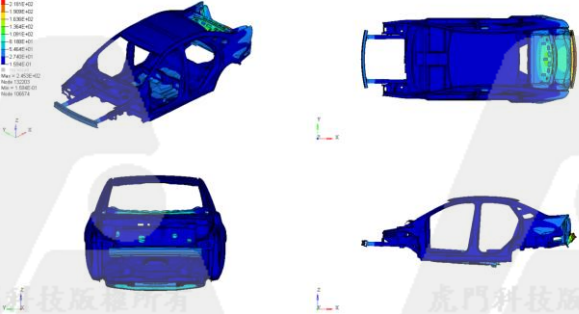
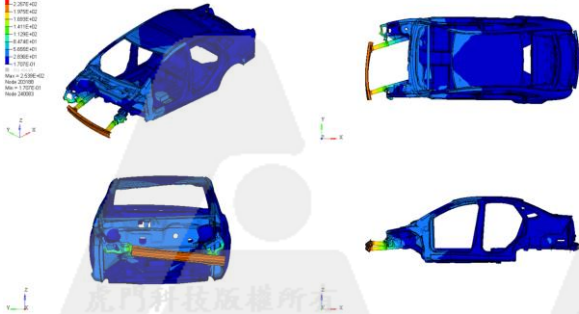


Optimization

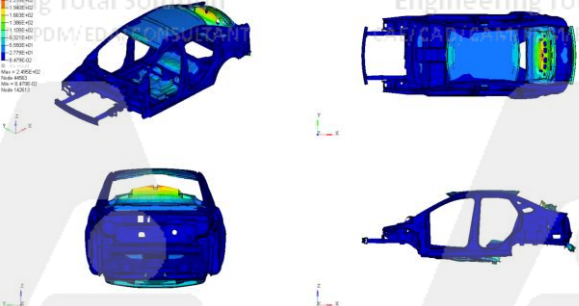
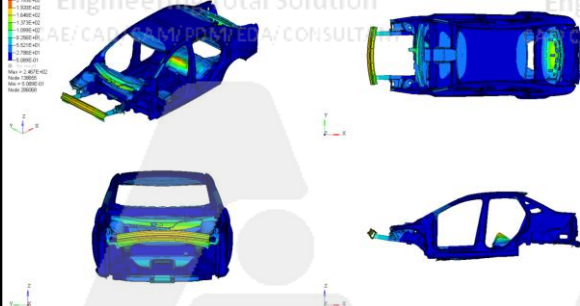
Base on Mode Shape Result



Modal Analysis Result

Optimization Design 3 (USUM)			
φ_n	1 st Mode Shape	φ_n	2 nd Mode Shape
	23.10 Hz		24.91 Hz
Global Shear Mode		Global Torsion Mode	
φ_n	3 rd Mode Shape	φ_n	4 th Mode Shape
	33.12 Hz		37.03 Hz
Local Bending Mode (Rear End & Package)		Local Shear Mode (Front End)	

Modal Analysis Result

Optimization Design 3 (USUM)			
φ_n	5 th Mode Shape	φ_n	6 th Mode Shape
	38.14 Hz		41.43 Hz
Local Bending Mode (Battery & Package)		Local Bending Mode (Rear Floor, Firewall, Package)	

Type\Items	Bending Stiffness (N/mm)	Torsion Stiffness (N-m/degree)	Weight (kg)
	4614.89	5680.90	358.21
Improved (%)	69.41	9.58	2.40

Impact Simulation

- Side Impact (FMVSS 214)
- Rear Impact (FMVSS 301)

Gross Vehicle Weight

Model Information

Number of Element	565,012
Number of Node	546,033
Element Formulation	#16 Fully Integrated Shell
Weight	1238.60 kg

Drive Motor

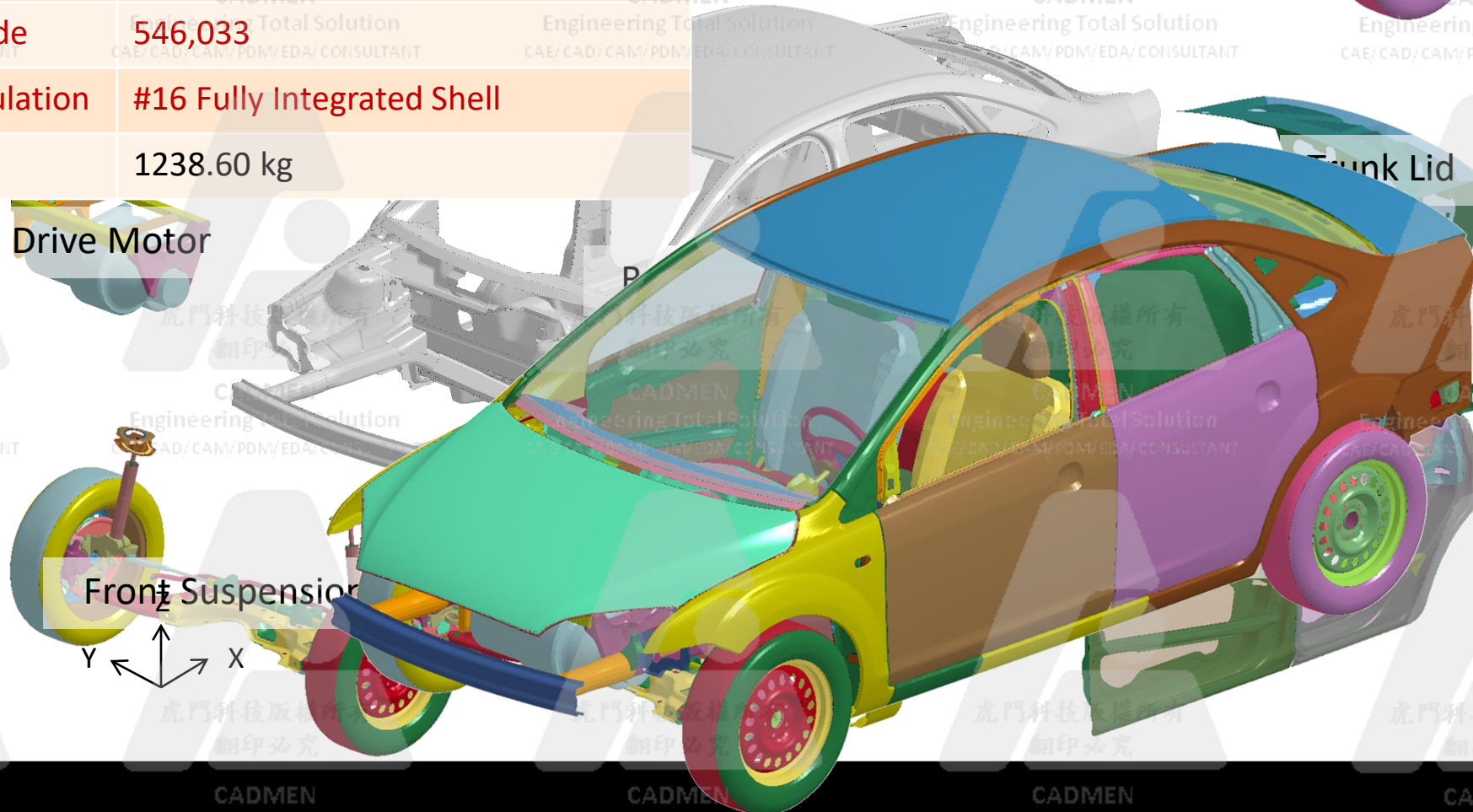
Fuel tank

Generator

Rear Suspension

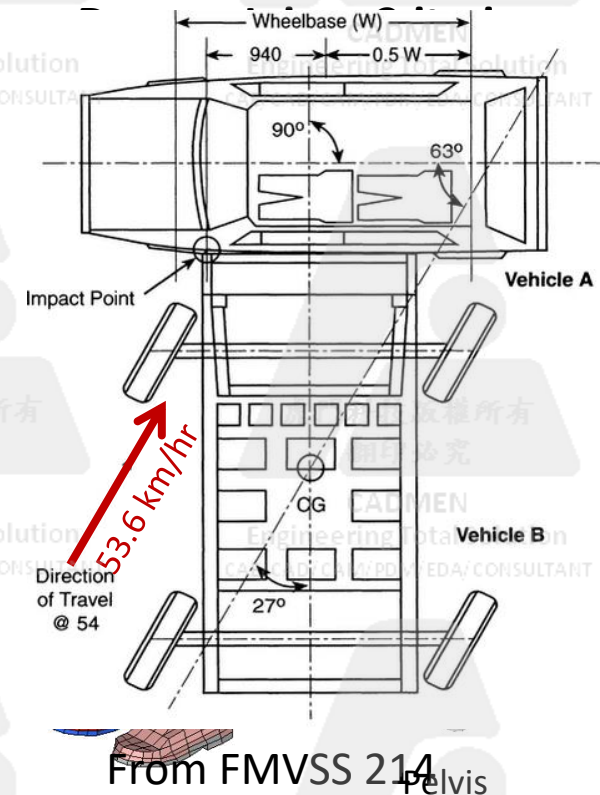
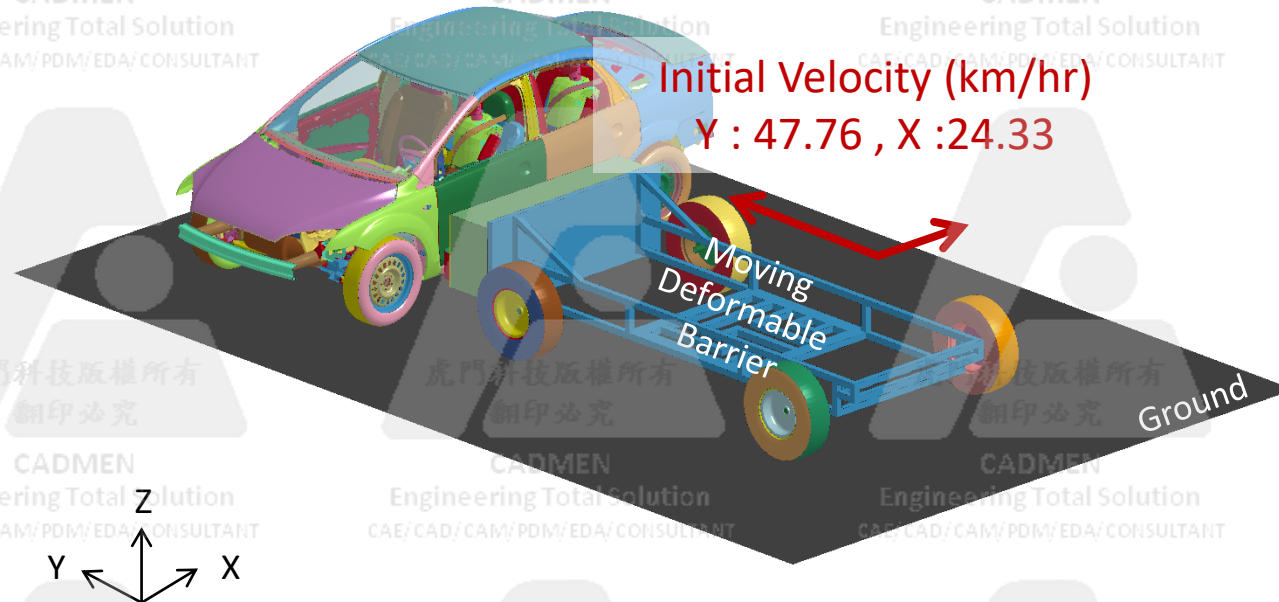
Trunk Lid

Front Suspension



Side Impact Condition

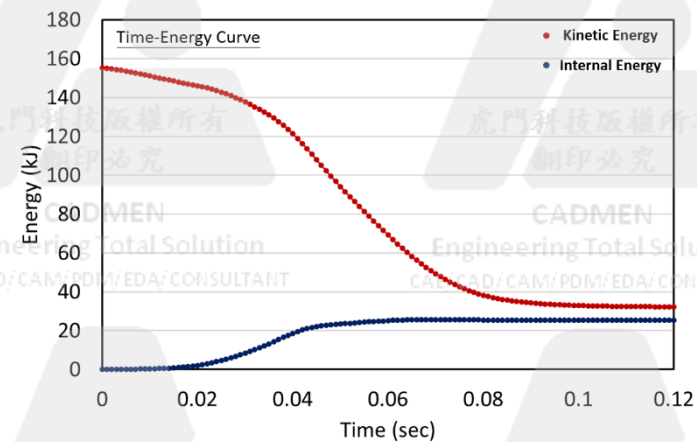
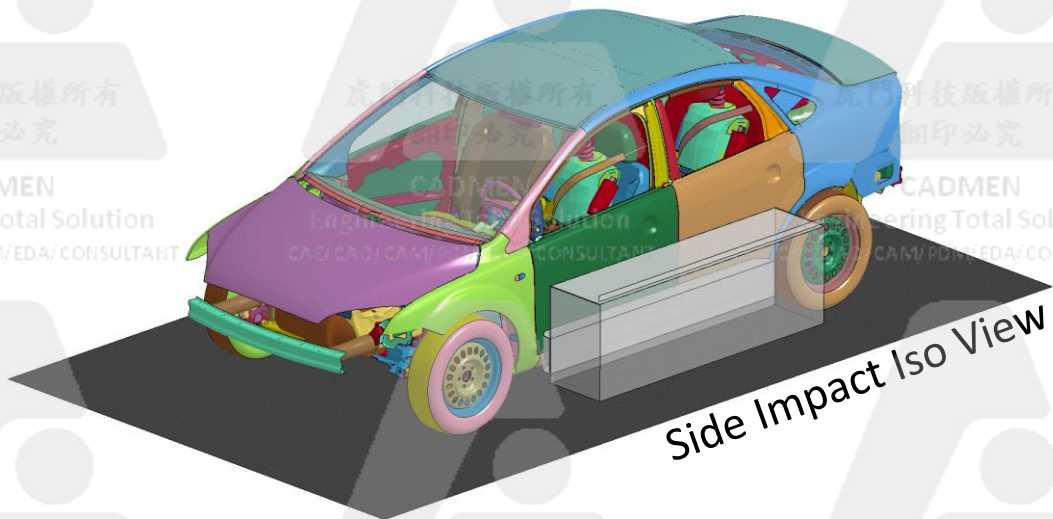
FMVSS 214 – Occupant Crash Protection
Vehicle Manufactured On or After 9/1 2014



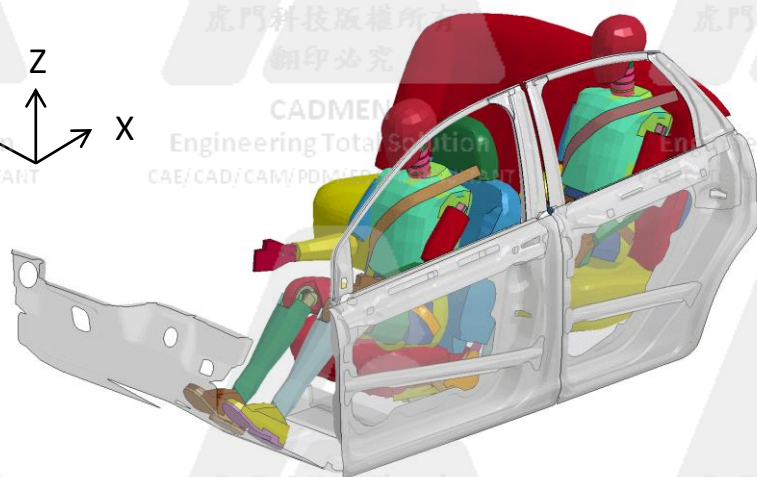
- **Vehicle Condition**

1. Two Occupant In Impact Side
2. Fuel Tank 92 to 94%
3. Add 300 kg Load In Package

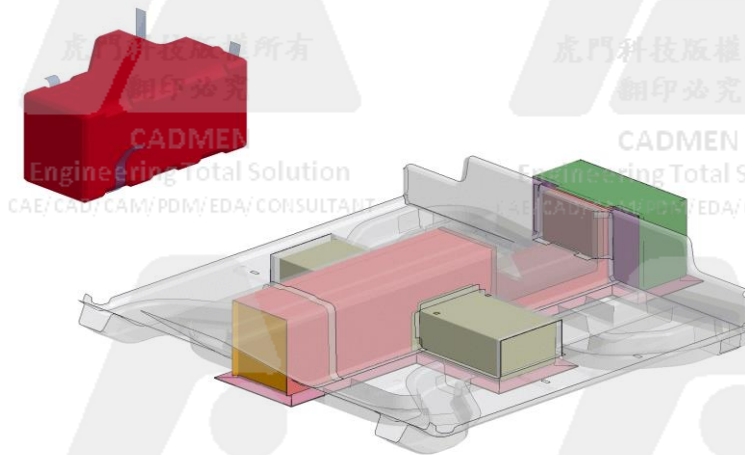
Result



Vehicle Energy Transfer



Dummy Impact Behavior



Process of Fuel Tank & Battery Impact

Rear Impact Condition

FMVSS 301 – Fuel System Integrity

Vehicle Manufactured On or After 9/1 2008

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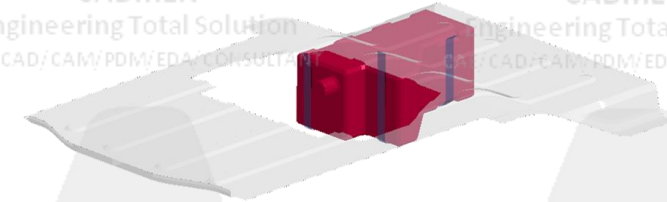
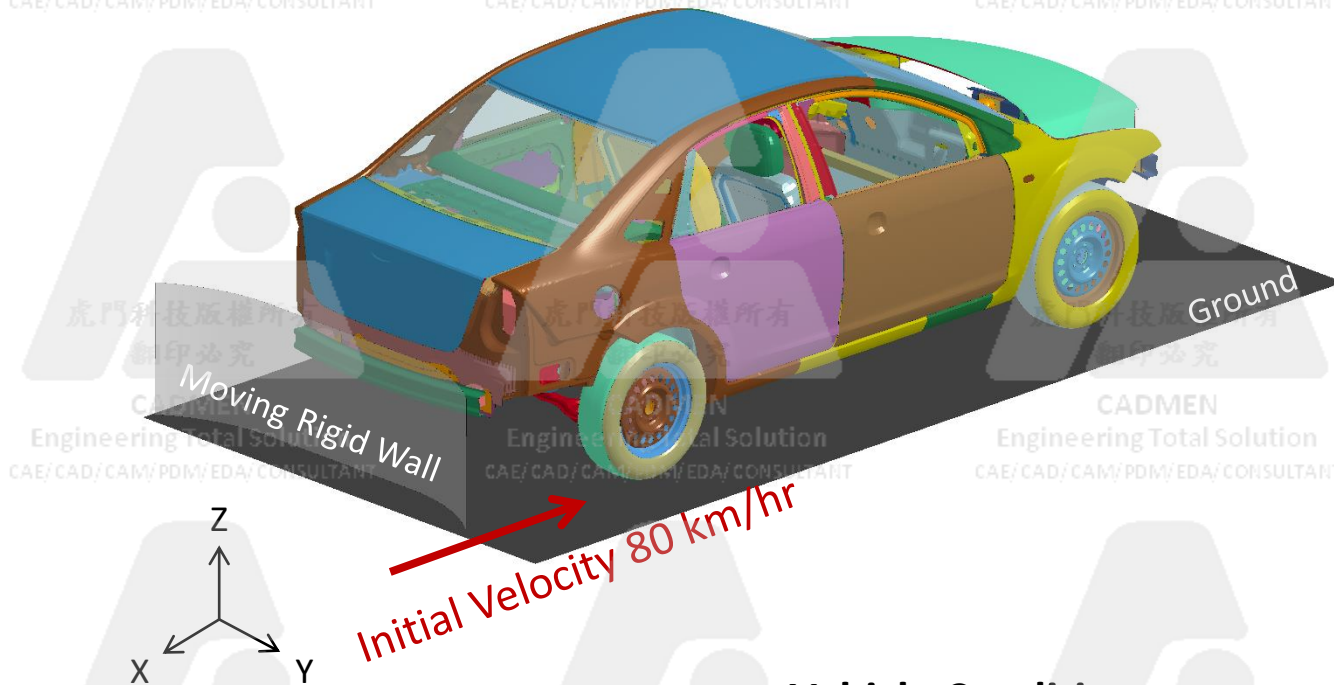
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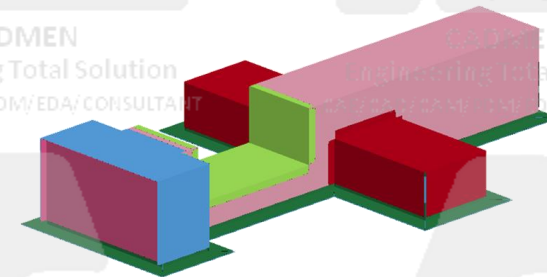
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Fuel Tank Damage



Battery Damage

- **Vehicle Condition**

1. Fuel Tank 90 to 95%

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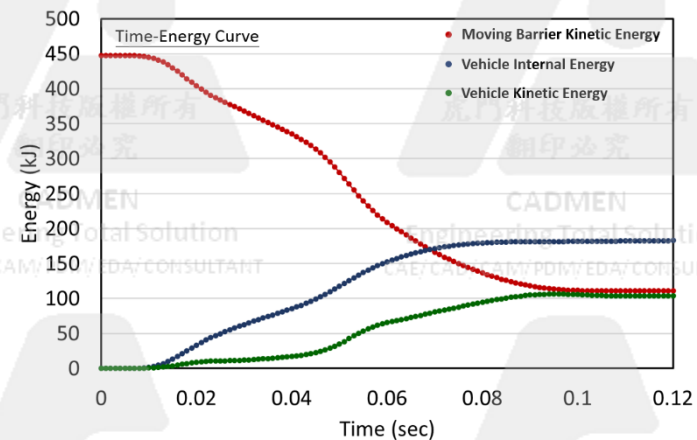
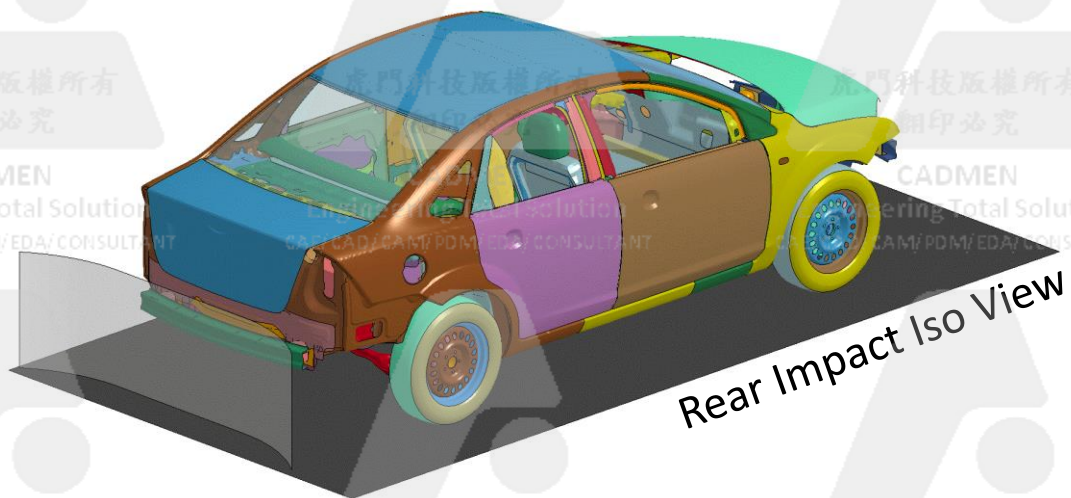
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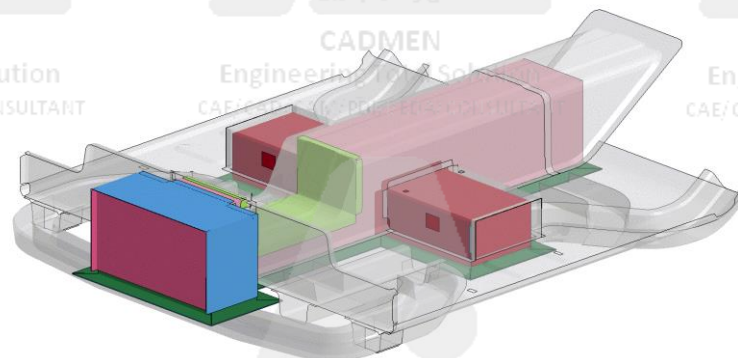
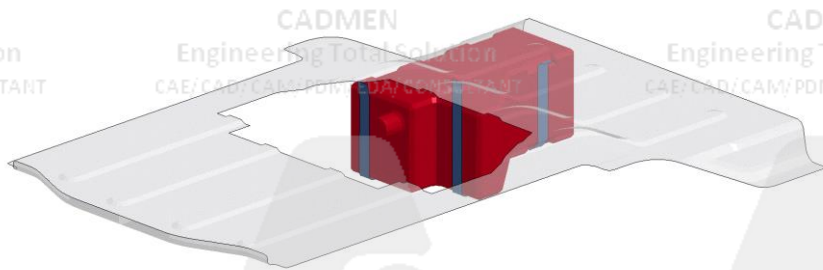
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Result



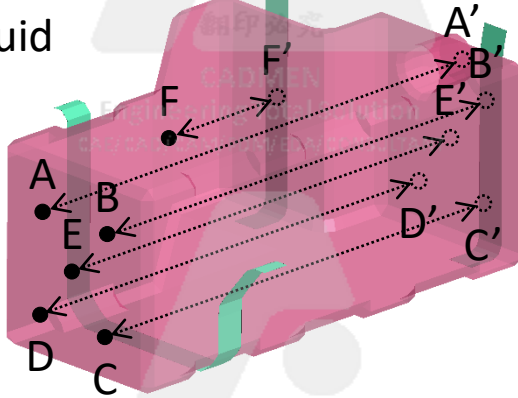
Vehicle & Rigid Wall Energy Transfer



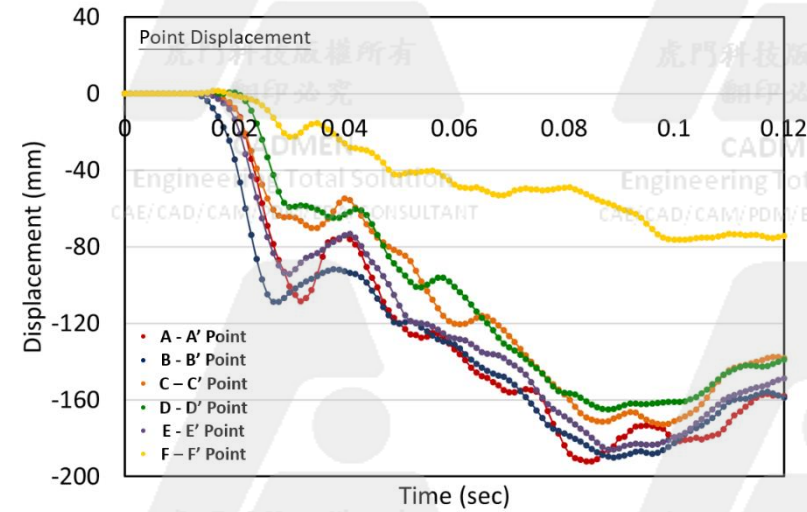
Process of Fuel Tank & Battery Impact

Damage Investigation

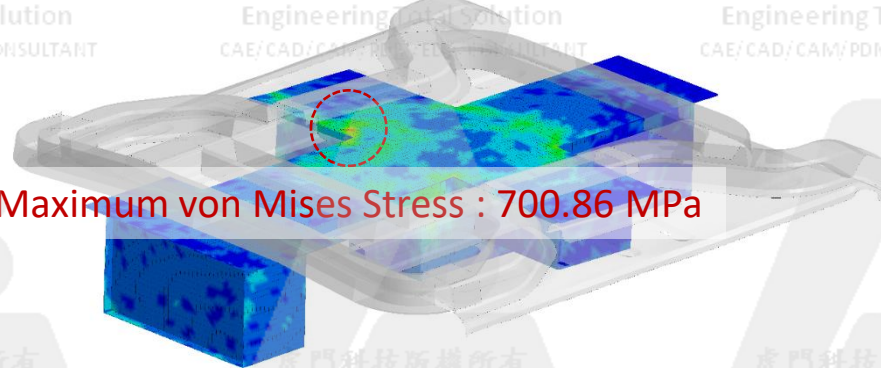
95% Liquid



Iso View



Maximum von Mises Stress : 700.86 MPa



Summery

- Ansys LS-DYNA® 提供使用者更完善的求解機制
- 隱式求解與顯示求解可於同一介面下相互應用與繼承
- 使用相同元素
- 相同材料資料庫
- 同一目標模型
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- 應用於線性/非線性 靜態分析、模態分析、震動相關之評估計算
- 降低使用者於動態 靜態間模型轉換之失誤，以提升效率



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2022/R1

Engineering Total Solution Engineering What's Ahead.
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新技術線上研討會

4/7 (四)
14:00-14:40

Ansys CFD 進階應用_TurboWorkflow
新技術線上研討會

李奕璋

4/7 (四)
15:00-15:40

Ansys Rocky 新技術線上研討會
(Ansys Fluent、Motion & OptiSLang 耦合應用技術)

林健文

4/7 (四)
16:00-16:40

Ansys GRANTA 碳足跡應用與產業成功案例分享-
新技術線上研討會

李易軒

NVIDIA QUADRO RTX 4000

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